CLAIMS

What is claimed is:

1. An apparatus for automated specimen processing, comprising:

a supporting framework;

a microwave unit attached to the framework comprising a sealable microwave chamber, a microwave source for producing microwaves within the chamber, and power supply means for providing power to the microwave source;

microwave chamber sealing means attached to the microwave chamber;

microwave source control means electrically connected to the microwave source;

at least one microwave tank located within the microwave chamber;

a specimen positioning device attached to the framework that transports the specimen into and out of the microwave chamber; and

specimen positioning device control means electronically connected to the specimen positioning device.

2. The apparatus of claim 1, wherein the microwave source control means comprises a real-time microwave processor.

3. The apparatus of claim 2, wherein the microwave source control means comprises a temperature sensor for measuring the temperature of the solution in one of the microwave tanks.

4. The apparatus of claim 3, wherein the microwave chamber further comprises an inner base wherein a plurality of microwave tanks are positioned.

5. The apparatus of claim 3, wherein the microwave source control means further comprises means to adjustably control the solution temperature of each of the microwave tanks

located within the microwave chamber.

6. The apparatus of claim 5, wherein the means to adjustably control the solution temperature of the microwave tanks comprises means to control power to the microwave source by thermocouple and set point.

7. The apparatus of claim 5, wherein the means to adjustably control the solution temperature of the microwave tanks comprises means to control a baffle in the microwave chamber by thermocouple and set point.

8. The apparatus of claim 1, wherein the specimen positioning device comprises a holding element, a three-axis step-motor-driven positioning element that positions the holding element, and holding element control means.

9. The apparatus of claim 1, wherein the specimen positioning device control means comprises a computer-operated motion controller.

10. The apparatus of claim 1, further comprising a specimen identification device attached to the specimen positioning device.

11. The apparatus of claim 10, wherein the specimen identification device comprises a barcode reading scanner.

12. The apparatus of claim 1, further comprising a fluid delivery system comprising a conduit having a first end for attachment to an outlet on a fluid source and a second end directing output of the conduit into a tank attached to the framework directly or indirectly and located inside or outside of the microwave chamber, and fluid delivery control means for regulating output from the conduit.

13. The apparatus of claim 12, wherein the fluid delivery control means comprises a programmable computer system controlling an electrically-operated valve that opens and closes the conduit.

14. The apparatus of claim 12, wherein the fluid delivery system comprises a plurality of conduits each having a first end for attachment to an outlet on a plurality of fluid

sources, comprising means for fluid level detection, and each conduit having fluid delivery control means for regulating the delivery of fluid from a second end of each conduit into a tank attached to the framework.

15. The apparatus of claim 12, further comprising a plurality of microwave tanks, wherein the fluid delivery system comprises a plurality of conduits that are joined at first ends to form a manifold and that have a plurality of second ends each directing output into a different tank attached to the framework.

16. The apparatus of claim 1, further comprising an outflow system on the microwave tank, the outflow system comprising an outflow valve, a drainage pump, an outflow valve control means, and at least one waste reservoir comprising means for fluid level detection.

17. The apparatus of claim 1, further comprising at least one staining tank attached to the framework outside of the microwave chamber.

18. The apparatus of claim 1, further comprising at least one rinse tank attached to the framework outside of the microwave chamber.

19. The apparatus of claim 18, further comprising means for fluid level detection in each rinse tank.

20. The apparatus of claim 19, wherein the means for fluid level detection uses pressure sensor means.

21. The apparatus of claim 19, wherein the means for fluid level detection uses optical sensor means.

22. The apparatus of claim 19, wherein the means for fluid level detection uses electrical sensor means.

23. The apparatus of claim 1, further comprising at least one holding tank attached to the framework outside of the microwave chamber for storing the specimen in a solution.

24. The apparatus of claim 23, further comprising means for fluid level detection in

each holding tank.

25. The apparatus of claim 24, wherein the means for fluid level detection uses pressure sensor means.

26. The apparatus of claim 24, wherein the means for fluid level detection uses optical sensor means.

27. The apparatus of claim 24, wherein the means for fluid level detection uses electrical sensor means.

28. The apparatus of claim 1, further comprising means for fluid level detection in each microwave tank.

29. The apparatus of claim 28, wherein the means for fluid level detection uses pressure sensor means.

30. The apparatus of claim 28, wherein the means for fluid level detection uses optical sensor means.

31. The apparatus of claim 28, wherein the means for fluid level detection uses electrical sensor means.

32. The apparatus of claim 1, further comprising means for exchanging the air in the microwave chamber.

33. The apparatus of claim 32, wherein means for exchanging the atmosphere in the microwave chamber comprises an internal exhaust fan and at least one atmospheric filter.

34. The apparatus of claim 1, wherein the apparatus can operate on either 110 VAC or 220 VAC.

35. An apparatus for automated specimen processing, comprising: A

a supporting framework;

a microwave unit attached to the framework comprising a sealable microwave chamber

attached to the framework, a microwave source attached to and directing microwaves into the chamber, and power supply means electrically connected to the microwave source;

microwave chamber sealing means attached to the chamber;

an interlock sensor electrically connected to the microwave source that delivers a signal when the microwave chamber is not sealed which prevents the production of microwaves by the microwave source;

microwave source control means electrically connected to the microwave source comprising a real-time microwave processor, a temperature sensor for measuring the temperature of the solution in the microwave tank, and a programmable computer system;

at least one microwave tank located within the microwave chamber, wherein each microwave tank has means for fluid level detection and an outflow system leading out of the chamber for removing a solution from the microwave tank, the outflow system comprising an outflow valve, a drainage pump and outflow valve control means;

means for controlling microwave tank solution temperature;

a specimen positioning device attached to the framework comprising a holding element, a three-axis step-motor-driven positioning element that positions the holding element, and a computer-operated motion controller that controls the positioning element and the holding element;

a barcode reading scanner attached to the specimen positioning device and electrically connected to a programmable computer system;

a loading area located attached to the framework outside of the microwave chamber for retaining the specimen prior to heating;

a rinse tank attached to the framework outside of the microwave chamber comprising means for fluid level detection;

at least one holding tank attached to the framework outside of the microwave chamber

for storing the specimen, and comprising means for fluid level detection; and

a fluid delivery system comprising a conduit having a first end for attachment to an outlet on a fluid source, comprising means for fluid level detection, and a second end directing output of the conduit into the microwave tank, fluid delivery control means regulating output from the conduit, and at least one waste reservoir comprising means for fluid level detection.

36. An automated method for dewaxing a specimen, comprising:

transporting the specimen into a microwave tank in a microwave chamber using a computer-controlled specimen positioning device;

providing a dewaxing solution within the tank; and

heating the dewaxing solution and specimen using a computer-controlled microwave unit so that the solution maintains a temperature of from about 60°C to just below the solution boiling point for at least about 3 minutes.

37. The method of claim 36, further comprising replacing the dewaxing solution with fresh dewaxing solution and heating the fresh dewaxing solution and specimen using the computer-controlled microwave unit so that the fresh dewaxing solution maintains a temperature of from about 60°C to just below the solution boiling point for at least about 3 minutes.

38. An automated method of hematoxylin and eosin staining, comprising:

transporting a specimen into a hematoxylin tank using a computer-controlled specimen positioning device;

providing a solution of hematoxylin in the hematoxylin tank;

contacting the specimen with the hematoxylin solution for a time sufficient to stain the specimen with sufficient hematoxylin to be detected by light microscopy;

transporting the specimen into a rinse tank;

providing rinse solution in the rinse tank;

contacting the specimen with the rinse solution for a plurality of times sufficient to minimize specimen background and maximize the useful lifetime of staining solutions;

transporting the specimen into an eosin tank using a computer-controlled specimen positioning device;

providing a solution of eosin in the eosin tank;

contacting the specimen with the solution of eosin for a time sufficient to stain the specimen with sufficient eosin to be detected by light microscopy; and

removing the specimen from the solution of eosin using a computer-controlled specimen positioning device.

39. The method of claim 38, further comprising:

transporting the specimen into a rinse tank;

providing rinse solution in the rinse tank;

contacting the specimen with the rinse solution for a plurality of times sufficient to minimize specimen background and maximize the useful lifetime of differentiating solutions;

transporting the specimen into a differentiation tank using a computer-controlled specimen positioning device;

providing a differentiation solution in the differentiation tank; and

contacting the specimen with the differentiation solution and then with a clearing solution to prepare for permanent mounting.

40. An automated method of antigen retrieval or nucleic acid retrieval, comprising:

transporting a specimen into a microwave tank in a microwave chamber using a computer-controlled specimen positioning device;

providing a solution within the tank;

heating the solution and specimen in the tank using a computer-controlled microwave unit so that the solution maintains a temperature of from about 50°C to just below the solution boiling point for a period of time sufficient to enhance immunostaining of the specimen; and

allowing the heated solution containing the specimen to gradually cool.

41. The method of claim 40, further comprising unsealing the microwave chamber.

42. The method of claim 40, wherein the solution is chelating agents, citrate salts, metal ions, Citra, Citra Plus, AR-10, or Glyca.

43. The method of claim 36, wherein the apparatus first moves a specimen identification device attached to the specimen positioning device to at least one work area of the apparatus selected from the group consisting of a loading area, the microwave tank, a staining

tank, a rinse tank and a holding tank to determine if a specimen is already present in the work area.

44. The method of claim 38, wherein the apparatus first moves a specimen identification device attached to the specimen positioning device to at least one work area of the apparatus selected from the group consisting of a loading area, a microwave tank, the eosin tank, the hematoxylin tank, a differentiation tank, a staining tank, a rinse tank and a holding tank to determine if a specimen is already present in the work area.

45. The method of claim 40, wherein the apparatus first moves a specimen identification device attached to the specimen positioning device to at least one work area of the apparatus selected from the group consisting of a loading area, the microwave tank, a staining tank, a rinse tank and a holding tank to determine if a specimen is already present in the work area.

46. A process for tracking a plurality of specimens, comprising identifying each of the specimens using a specimen identification device attached to a three-axis computer-controlled specimen positioning device, assigning a unique location within a computer memory system to each specimen using a computer program, and updating the location of each specimen as the computer-controlled specimen positioning device moves each specimen to different locations in the apparatus while performing an automated histotechnological method.

47. The apparatus of claim 1, wherein the microwave tank accommodates slide racks of a plurality of sizes and/or shapes.

48. The apparatus of claim 35, wherein the loading area accommodates slide racks of a plurality of sizes and/or shapes.

49. A microscope slide comprising an identification label on an edge of the slide.

50. The microscope slide of claim 49, wherein the identification label is optically detectable.

51. The microscope slide of claim 49, wherein the identification label is a barcode.

52. An automated method for dewaxing and antigen retrieval of a specimen, comprising:

transporting the specimen into a microwave tank in a microwave chamber using a computer-controlled specimen positioning device;

providing a dewaxing solution within the tank;

heating the dewaxing solution and specimen using a computer-controlled microwave unit so that the solution maintains a temperature of from about 60°C to just below the solution boiling point for at least about 3 minutes to about 10 minutes;

replacing the dewaxing solution with a fresh solution within the tank;

heating the solution and specimen in the tank using a computer-controlled microwave unit so that the solution maintains a temperature of from about 50°C to just below the solution boiling point for a period of time sufficient to enhance immunostaining of the specimen; and

allowing the heated solution containing the specimen to gradually cool.

53. The method of claim 52, further comprising unsealing the microwave chamber.

54. The method of claim 52, wherein the fresh solution is chelating agents, citrate salts, metal ions, Citra, Citra Plus, AR-10, or Glyca.

55. The apparatus of claim 35, wherein the specimen positioning device comprises means for sensing slide racks.